A NEW NEMATODE PARASITE OF A LIZARD.

By Vera Irwin Smith, B.Sc., F.L.S., Linnean Macleay Fellow of the Society in Zoology.

(Seventeen Text-figures.)

[Read 30th August, 1922.]

Two specimens of a nematode, remarkable for the possession of an asymmetrical row of spines down one side, are included in Dr. J. B. Cleland's collection of helminths from Australian reptiles. They were preserved in 70% alcohol, in a phial with one specimen of a *Physaloptera* sp., and one Oxyurid, all taken from the alimentary tract of a small lizard, the enclosed label bearing the inscription "Nematodes from lizard (Hinulia) No. 2, alimentary canal. Flinders Is. 25/11/12. Dr. J. B. C."

In general appearance these worms are very like *Physaloptera* and, at first, they were taken to be identical with the small *Physaloptera* sp. found with them. A closer examination revealed the spine row, and proved the distinctive character of the specimens.

A cuticular ornamentation of spines is rare in reptilian nematodes, and the asymmetrical position of the row in this case gives an added interest and significance to the new form. So far as I am aware, nothing of the same kind has been described before. The nearest approach to it is found in the original descriptions of *Rictularia cristata* Froelich, the type species of a genus which has been recorded only from mammals, and the new nematode has been assigned, provisionally, to this genus, although it does not conform to the generic diagnosis as given by recent writers, Jagerskiold (1909) and Hall (1914). The discrepancies noted can be discussed better after the description of the new species, when its relationships and systematic position will be considered.

Unfortunately the only two specimens available are both females, so that the specific characters of the male can not be determined. There is also some doubt about the exact structure of the mouth parts in the two females examined, which are very small and not in good condition. Under the circumstances, it does not seem advisable to propose a new genus for the species at present, though this may be necessary when fuller information is obtainable.

Rictularia disparilis, n.sp.

Male unknown.

Female 7.9 to 8.7 mm. long. Colour whitish when preserved in alcohol, original colour not noted. Body slender, delicate, thickest in the posterior third,

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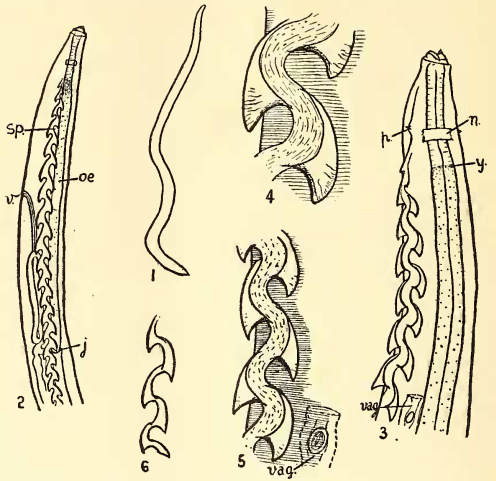
Female 7.9 to 8.7 mm. long. Colour whitish when preserved in alcohol, original colour not noted. Body slender, delicate, thickest in the posterior third,

attenuating towards the anterior (Text-fig. 1). Maximum diameter 320 μ, diminishing to 64 μ at the base of the lips. Tail short, straight, and conical, with a mucronate tip; anus 112 μ from the extremity; caudal pores 55 μ distant from it (Text-fig. 17). Diameter of body at anus 128 μ. Details of the structure of the mouth and buccal cavity are not very clear in the two whole preparations, and the limited amount of the material prevents any other mode of examination. The mouth is in the form of a transverse cleft, which lies only very slightly, if



1. Female (× 7.5); 2. Anterior part of body, viewed from left side, showing spine ridge (sp.) (× 47.5); 3. Dorso-lateral view of anterior region (× 100); 4. Portion of spine ridge near anterior end (× 305); 5. Portion of spine ridge in region of vulva (× 190); 6. Posterior termination of spine ridge (× 100).

j., junction of oesophagus and intestine; n., nerve ring; oe., oesophagus; p., post-cervical papillae; v., vulva; vag., vulva and vagina on ventral side, seen through the transparent body; y., junction of muscular and glandular oesophagus.

at all, lateral of the dorso-ventral plane. The two lips which bound it are lateral in position, and asymmetrical (Text-figs. 7-9). The right is higher than the left, and is crowned by a stout conical median tooth, similar to the external labial tooth of the genus *Physaloptera*. The tooth is about 5 μ high, and 6 μ wide at base, and appears to have a very small denticle on its inner face, though this could not be definitely determined. The appearance of lobes on the inner

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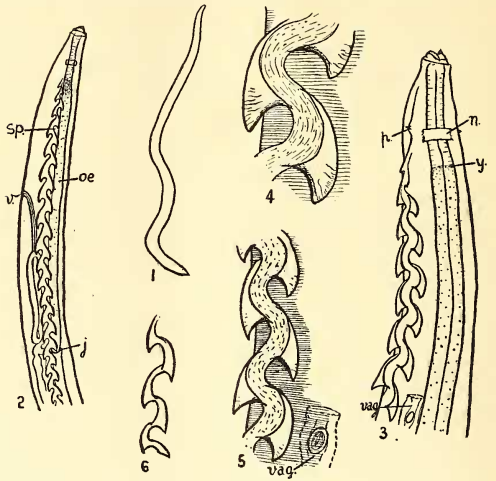

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face of the lip, with a row of denticles along their margin, is also indefinite. The lower, left, lip does not bear a large median tooth, but appears to consist of a series of three or more fairly sharply pointed lobes, having denticles on their summits. Applied externally to each lip is a thick, hemispherical pad, on which two large papillae are visible. The right lip is 13 μ from summit to base, the left lip 10 μ. The buccal cavity is short and narrow. A capsular armature, if present, is not discernible. Round the base of the lips, the cuticle projects slightly, forming a narrow cephalic collarette; and, at a distance of 11 to 18 μ behind the collarette, there is a prominent circular ridge, with a deep groove in front of it.

The oesophagus is long and slender, 1/4.9 to 1/5.3 of the total body length (Text-fig. 10). It is formed of two parts, a short muscular portion followed by a darker glandular oesophagus, the boundary between them being clearly marked. The total length of the oesophagus is 1.63 mm., the muscular oesophagus being .26 mm. long and 33 μ wide. The glandular oesophagus increases gradually in width posteriorly, to a maximum of 96 μ. Its base is rounded and the entrance to the intestine is protected by valves (Text-fig. 11).

The vulva is situated ventrally at about the middle of the length of the oesophagus, .80 mm. from the anterior extremity of the body (Text-figs. 2, 10). The nerve-ring surrounds the muscular oesophagus a little behind its middle, at a distance of 185 μ from the anterior end, and, on a level with the nerve-ring, a pair of thorn-shaped post-cervical papillae are situated on the lateral lines (Text-fig. 3). The excretory pore opens on the mid-ventral line about 25 μ behind these.

Extending down the left side of the body, from just behind the left post-cervical papilla, and in the same plane with it, is a continuous, regular, wavy ridge, which bears, on the crest of each wave and therefore to right and left, alternately, of the ridge, an oblique, backwardly-directed cuticular spine (Text-figs. 2-6). No trace of a similar ridge, nor of any other spines exists on the right side, or elsewhere on the body. The spines may be regarded as forming a double row, since they point alternately in opposite directions; but the double row is quite certainly asymmetrical. Except on the spine ridge, the cuticular integument is everywhere transversely striate, the striae being very fine and dense, about 2 μ apart.

Anteriorly, the spines begin just on a level with the junction of muscular and glandular oesophagus, about 92 μ behind the left post-cervical papilla and 277 μ behind the anterior end of the body. Posteriorly, they extend to within 1.84 to 2 mm. of the tip of the tail. They are of the same character throughout the length of the row, having the shape of strongly curved, pointed thorns, slightly rugose along the crest, and standing up in low relief from the body. Being colourless and transparent, they can only be made out with difficulty when viewed against the background of the body, especially in the posterior region. Fifty-four spines are found on each side of the ridge, making a total of 108 spines in the double row. They vary a little in size, being smallest towards each end, gradually increasing to a maximum between the vulva and the posterior end of the oesophagus, i.e., from the seventh to the seventeenth pair of spines from the anterior end. Their maximum size is 48 μ in length, and 25 μ in height. At the anterior end of the row they measure 22 μ in length and 7 μ in height; at the fortieth pair 33 μ in length, and 18 μ in height. The width across the ridge, between the tips of the spines on each side, varies correspondingly from 55 μ at the seventh pair, in the region of the vulva, to 74 μ at the fifteenth pair, and 51 μ

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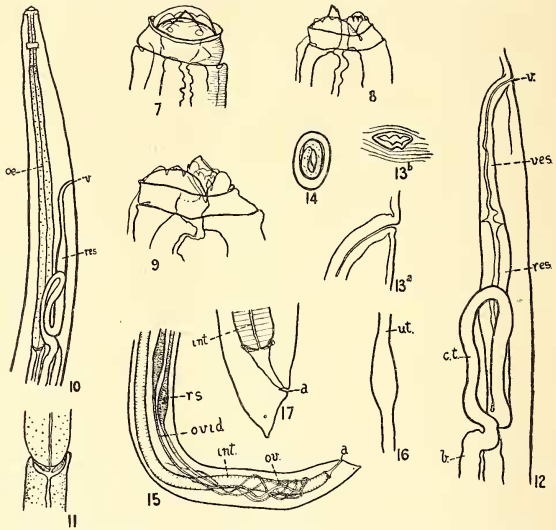
at the fortieth pair. The interval between the tips of consecutive spines on the same side is 77 μ at the beginning of the row, 125 μ at the seventeenth spine, 136 μ at the twentieth, and 114 μ at the fortieth.

Both the specimens examined are mature females, having uteri crammed with eggs containing well-developed embryos. The genital system is situated posterior to the vulva, and almost entirely on the ventral side of the body. The very



7. Head end viewed from the right side (× 305); 8. The same, ventral view (× 305); 9. The same, dorso-lateral view (× 475); 10. Anterior part of body, viewed from right side (× 47.5); 11. Junction of oesophagus and intestine (× 100); 12. Terminal portion of female genital system (× 100); 13a. Vulva, side view. 13b. Vulva, face view (× 190); 14. Egg from uterus (× 305); 15. Posterior part of body (× 27); 16. Receptaculum seminis (× 100); 17. Caudal extremity of female (× 100).

a., anus; b., the two branches of the common trunk leading to the uteri; c.t., common trunk; int., intestine; oe., oesophagus; ov., ovary; ovid., oviduct; res., reservoir; r.s., receptaculum seminis; v., vulva; ves., vestibule.

anterior vulva, 1/9.5 to 1/11 of the body length from the anterior end, is bounded by non-salient lips with serrated margins (Text-figs. 13*a*, *b*). It leads into a straight, backwardly-directed vestibule, with thick musculo-cuticular walls, 320 μ long and 30 μ wide (Text-fig. 12). This passes abruptly into a broader tube, 55 μ wide, with walls lined by large epithelial cells, which appears to be of the

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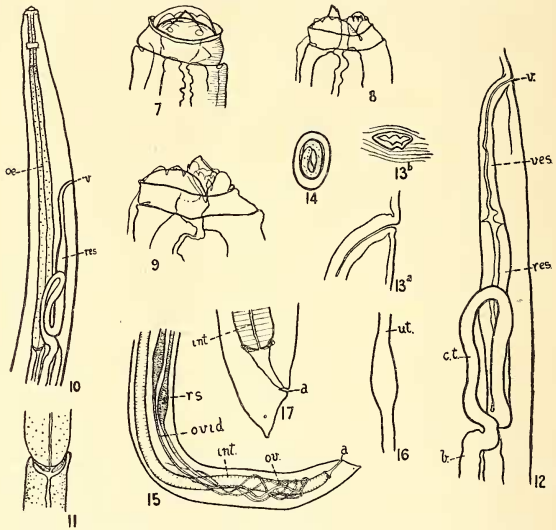

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nature of a reservoir, although only a few eggs are present in it. It is directed either straight back, or curved forward on the vestibule, and is followed by a common trunk 576 μ long and 37 μ wide, folded on itself and divided posteriorly into two branches which lead into the two posteriorly-directed uteri. These are distended with eggs and measure, at their maximum width, 92 μ. They are coiled in the middle region of the body, the most anterior loop being found at .85 to 1.52 mm. from the anterior extremity of the body, and the most posterior at 2 mm. from the posterior extremity. Each uterus terminates in a slight enlargement, dark in colour, the receptaculum seminis, which leads without abrupt transition into the oviduct (Text-fig. 16). The receptacula seminis are found at a distance of 1.5 mm. to 1.8 mm. from the posterior end, not far from the position of the posterior termination of the spine row (Text-fig. 15). The two ovaries are much coiled in the region between this and the anus, extending to within .35 mm. of the extremity of the body.

The eggs are broadly oval, with clear, thick shells, measuring 38 μ in length and 25 μ in transverse diameter (Text-fig. 14).

Host.—Hinulia sp. *Location.*—Alimentary canal. *Locality.*—Flinders Island, Bass Strait. Collected by Dr. J. B. Cleland, November 25, 1912.

Paratype in the Australian Museum, Sydney (Registered No. W. 923).

Hinulia, a subgenus of *Lygosoma,* is very widely distributed throughout Australia, the commonest species about Sydney being *Lygosoma* (*Hinulia*) *taeniolatum* Shaw. It was probably from this species that the above-described nematodes were taken. Two other specimens of *Hinulia,* species not determined, are represented in Dr. Cleland's collection as hosts for nematodes, one taken at North Bay in October, 1914, the other at Flinders Island on the same date as the specimen from which the *Rictularia disparilis* were obtained. The only nematodes collected from them are Oxyuriidae, one female from the North Bay specimen, and four females from "Hinulia No. 5, Flinders Is." There is, in addition, one female Oxyurid from "a small lizard, Flinders Is.," taken at the same time as the two Hinulia.

Dr. T. H. Johnston's catalogues of Australian reptilian Entozoa (1912 and 1916), contain records of Entozoa from three species of *Hinulia,* viz., *taeniolatum, quoyi* and *tenue*; but only one of these refers to a nematode, and that is a species of *Physaloptera* from *Hinulia tenue* Gray.

The other lizard hosts in the Cleland collection are *Varanus* sp., *Lialis burtoni* and *Gymnodactylus platurus,* and the nematodes from these all belong to the genus *Physaloptera.* The new form described here is, therefore, evidently rare. Apparently nothing like it has been observed before in any Australian reptile, the only nematodes listed in the catalogues being all species of the four genera *Ascaris, Strongylus, Filaria,* and *Physaloptera.*

Among birds, one nematode with a cuticular ornamentation of spines has been recorded in Australia. This was found in a sea-bird, *Daption capensis* (Cape Petrel), and was listed by Dr. T. H. Johnston as *Rictularia shipleyi* Stoss. (1912). However, Dr. Johnston adds the explanatory note—"This record is based upon material collected near Sydney by Mr. L. Harrison. His description of the parasite satisfies me that the worm was *Rictularia,* and most probably *R. shipleyi.* Unfortunately, the nematodes have been mislaid, and I am therefore, at present, unable to confirm the specific identity" (1912, p. 106). The species referred to was described originally by Stossich as *Gnathostoma shipleyi* (from the great

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albatross, *Diomedea exulans*), and has recently been raised to a new genus, *Seuratia*, by Skrjabin (1916). He places it in the family Acuariidae, subfamily Acuariinae, and points out that it is identical with the species described by Linstow as *Rictularia paradoxa* and by Seurat as *Acuaria pelagica*.

The spines in the new form, from the lizard, differ entirely in character and arrangement from those described for the genus *Seuratia*; and, in the general structure of the body, it presents closer affinities with the Physalopterinae than with the Acuariinae.

It agrees with the genera *Physaloptera* and *Rictularia* in the structure of the oesophagus, the position of the nerve-ring, post-cervical papillae and excretory pore, the anterior situation of the vulva, the conformation of the various parts of the female genital system, and the eggs containing well developed embryo when oviposited. The cephalic collarette, though poorly developed, and the lateral lips, especially the right lip with its median tooth, recall those of *Physaloptera*. But the asymmetrical character of the lips, and the presence of a cuticular ornamentation of spines on the body separate it from *Physaloptera*. The deep groove and ridge dividing the head end from the rest of the body suggest affinities with *Gnathostoma*, but the anterior end of the body is not swollen, and the spines are quite differently arranged, while the vulva is situated very anteriorly, instead of behind the middle of the body as it is in the Gnathostomidae.

As already noted, *Rictularia disparilis* agrees with the descriptions given by Froelich and Dujardin of the type species of the genus, *R. cristata*, in having a single row of spines, of uniform character, set close together and situated asymmetrically on one side of the body; it differs, however, in the continuity and length of the row, which is not confined to the region in front of the vulva, as described for *R. cristata*. Modern writers have doubted the correctness of the accounts given by Froelich and Dujardin, although Dujardin specially emphasises the statement "une rangée non symmétrique." All the other species assigned to the genus have two rows of combs and spines, one down each side of the body, with a distinct difference between anterior combs and posterior spines. Hall (1914, 1916) concludes that the original descriptions of the type species are based on imperfect observation, and that *R. cristata* had really two latero-ventral rows of spines, of which only the upper and nearer row was seen. Accordingly, Jagerskiold (1909) and Hall (1914), in their generic diagnoses include "two latero-ventral rows of comb or spine-like structures." But they point out that if Froelich's description should be confirmed, the generic diagnosis would need revision, and it would be necessary to establish a new genus for all the other species at present assigned to the genus.

Although Froelich's species was taken from a rodent, and the other species found in rodents, as well as in carnivores, possess two spine rows, the discovery of this new form from a lizard, which undoubtedly has only a single asymmetrical row, suggests the possibility that Froelich's and Dujardin's observations may have been correct.

Rictularia disparilis, however, differs from the other species included in the genus in another important character, namely, the structure of the buccal cavity and the position of its aperture.

It has been assumed that in Froelich's species the aperture is dorsal, as it is in the other species described. Accordingly, the diagnosis of the genus given by Hall defines the mouth opening as "more or less distinctly dorsal, and with its base armed with teeth and spines." In *R. disparilis*, owing to the asym-

albatross, *Diomedea exulans*), and has recently been raised to a new genus, *Seuratia*, by Skrjabin (1916). He places it in the family Acuariidae, subfamily Acuariinae, and points out that it is identical with the species described by Linstow as *Rictularia paradoxa* and by Seurat as *Acuaria pelagica*.

The spines in the new form, from the lizard, differ entirely in character and arrangement from those described for the genus *Seuratia*; and, in the general structure of the body, it presents closer affinities with the Physalopterinae than with the Acuariinae.

It agrees with the genera *Physaloptera* and *Rictularia* in the structure of the oesophagus, the position of the nerve-ring, post-cervical papillae and excretory pore, the anterior situation of the vulva, the conformation of the various parts of the female genital system, and the eggs containing well developed embryo when oviposited. The cephalic collarette, though poorly developed, and the lateral lips, especially the right lip with its median tooth, recall those of *Physaloptera*. But the asymmetrical character of the lips, and the presence of a cuticular ornamentation of spines on the body separate it from *Physaloptera*. The deep groove and ridge dividing the head end from the rest of the body suggest affinities with *Gnathostoma*, but the anterior end of the body is not swollen, and the spines are quite differently arranged, while the vulva is situated very anteriorly, instead of behind the middle of the body as it is in the Gnathostomidae.

As already noted, *Rictularia disparilis* agrees with the descriptions given by Froelich and Dujardin of the type species of the genus, *R. cristata*, in having a single row of spines, of uniform character, set close together and situated asymmetrically on one side of the body; it differs, however, in the continuity and length of the row, which is not confined to the region in front of the vulva, as described for *R. cristata*. Modern writers have doubted the correctness of the accounts given by Froelich and Dujardin, although Dujardin specially emphasises the statement "une rangée non symmétrique." All the other species assigned to the genus have two rows of combs and spines, one down each side of the body, with a distinct difference between anterior combs and posterior spines. Hall (1914, 1916) concludes that the original descriptions of the type species are based on imperfect observation, and that *R. cristata* had really two latero-ventral rows of spines, of which only the upper and nearer row was seen. Accordingly, Jagerskiold (1909) and Hall (1914), in their generic diagnoses include "two latero-ventral rows of comb or spine-like structures." But they point out that if Froelich's description should be confirmed, the generic diagnosis would need revision, and it would be necessary to establish a new genus for all the other species at present assigned to the genus.

Although Froelich's species was taken from a rodent, and the other species found in rodents, as well as in carnivores, possess two spine rows, the discovery of this new form from a lizard, which undoubtedly has only a single asymmetrical row, suggests the possibility that Froelich's and Dujardin's observations may have been correct.

Rictularia disparilis, however, differs from the other species included in the genus in another important character, namely, the structure of the buccal cavity and the position of its aperture.

It has been assumed that in Froelich's species the aperture is dorsal, as it is in the other species described. Accordingly, the diagnosis of the genus given by Hall defines the mouth opening as "more or less distinctly dorsal, and with its base armed with teeth and spines." In *R. disparilis*, owing to the asym-

metry of the lips, the mouth is not quite terminal in position; but as the lips are lateral, and the lower lip is on the left side, the opening is towards the side instead of dorsal. A close study of Froelich's figures and Dujardin's description suggests that this is also the case in *R. cristata*. Dujardin himself shows some doubt and confusion about the position of the mouth, and queries his own statement in regard to it. His confusion is evidently due to his assumption that the spine row is dorsal, and the vulva to one side of it, "située latéralement, ou presque à la face dorsale (?)." The lips, then, which are lateral in relation to the vulva, are taken to be dorsal and ventral in position. But it is probable that the vulva was in the normal, ventral position and, in that case, the spine row and the lips would occupy the same relative positions to it as they do in *R. disparilis*.

Dujardin does not mention any elaborate buccal armature at the base of the capsule, such as is present in the more recently described species, and nothing of the kind has been observed in *R. disparilis*. It is unfortunate that the material available does not permit of a clear determination of all the details of the mouth structure. But the relationship to *Physaloptera* is evident, and it seems probable that *Rictularia disparilis* and, perhaps, *R. cristata* represent transition forms between the simple *Physaloptera* type and the more highly specialised types of *Rictularia* with well developed, armed buccal capsule and two or three rows of spines down the body.

Its suggested systematic position would, therefore, be

Superfamily Spiruroidea Railliet and Henry, 1915.
Family Acuariidae Seurat, 1913.
Subfamily Physalopterinae Seurat, 1913.
Genus Rictularia Froelich, 1802.

Literature.

Dujardin, F., 1845.—Histoire naturelle des helminthes ou vers intestinaux. Paris (*Gnathostoma*, p. 287; *Rictularia*, pp. 280-281).

Hall, M. C., 1914.—A new nematode, *Rictularia splendida*, from the coyote, with notes on other coyote parasites. *Proc. U.S. Nat. Mus.*, 46, No. 2012, pp. 73-84, 6 figs.

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Postscript, added 4th September, 1922.—While this paper was in the press, further information obtained from Professor Cleland indicates that the host was *Lygosoma* (*Liolepisma*) *entrecasteauxii*, of which two specimens were examined.

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